Time trend of suicide in Swiss male farmers and comparison with other men: a cohort study

Steck, Nicole ; Junker, Christoph ; Bopp, Matthias ; Egger, Matthias ; Zwahlen, Marcel

Abstract: OBJECTIVE The ongoing agricultural reforms present serious challenges for Swiss farmers. Pressure is growing with difficult economic situations and the increasing demands for environmental protection, animal welfare and food safety. The aim of this study was to determine whether the strain is associated with higher risk of suicide in farmers than in men in other professions. We also wanted to analyse any changes in trends over time. METHODS Using the Swiss National Cohort, a population-based longitudinal study (1991ndash;2014), we investigated suicide rates for Swiss men aged 35 to 74 years who lived in small communities. We calculated crude rates of suicide and standardised mortality ratios (SMRs) for both calendar periods of four years, and overall. We estimated hazard ratios using Cox proportional hazard regression models of increasing complexity to examine associations with profession (farmer, non-farmer), calendar period, marital status, type of household, religion and language region. RESULTS We identified 9006 suicides among 1,796,379 men in the total study population, of which 447 occurred in 89,303 farmers. Age-standardised rates of suicide per 100,000 person-years were higher (38.1, 95% CI 34.6ndash;41.8) in farmers than in men with other professions (32.6, 95% CI 31.9ndash;33.3). Although the age-standardised rates decreased for the whole study population until 2006, the declining trend continued afterwards only in non-farmers. The widening gap between farmers and non-farmers also showed in the SMR, which increased from 1.06 (95% CI 0.88ndash;1.27) in the period 1991ndash;1994 to 1.37 (95% CI 1.05ndash;1.79) in 2011-2014. The Cox regression model analyses also revealed a higher risk of suicide for farmers, with hazard ratios ranging from 1.10 (95% CI 1.00ndash;1.22) to 1.17 (95% CI 1.07ndash;1.29). Usage of firearms was the most common method in the overall population (36.5%). In farmers, however, almost 60% committed suicide by hanging. CONCLUSION The study shows a higher rate of suicide in farmers compared to non-farmers in Switzerland, with the gap widening increasingly after 2006. It underlines the importance of identifying the difficulties and concerns of male farmers at an early stage in order to make appropriate structural adjustments and to offer low-threshold assistance tailored to their needs and preferences.

DOI: https://doi.org/10.4414/smw.2020.20251

Originally published at:
Steck, Nicole; Junker, Christoph; Bopp, Matthias; Egger, Matthias; Zwahlen, Marcel (2020). Time trend of suicide in Swiss male farmers and comparison with other men: a cohort study. Swiss Medical Weekly, 150:w20251.
DOI: https://doi.org/10.4414/smw.2020.20251

Established in 1871

Swiss Medical Weekly

Formerly: Schweizerische Medizinische Wochenschrift

An open access, online journal • www.smw.ch

Original article | Published 18 May 2020 | doi:10.4414/smw.2020.20251
Cite this as: Swiss Med Wkly. 2020;150:w20251

Time trend of suicide in Swiss male farmers and comparison with other men: a cohort study

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Summary

OBJECTIVE: The ongoing agricultural reforms present serious challenges for Swiss farmers. Pressure is growing with difficult economic situations and the increasing demands for environmental protection, animal welfare and food safety. The aim of this study was to determine whether the strain is associated with higher risk of suicide in farmers than in men in other professions. We also wanted to analyse any changes in trends over time.

METHODS: Using the Swiss National Cohort, a population-based longitudinal study (1991–2014), we investigated suicide rates for Swiss men aged 35 to 74 years who lived in small communities. We calculated crude rates of suicide and standardised mortality ratios (SMRs) for both calendar periods of four years, and overall. We estimated hazard ratios using Cox proportional hazard regression models of increasing complexity to examine associations with profession (farmer, non-farmer), calendar period, marital status, type of household, religion and language region.

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CONCLUSION: The study shows a higher rate of suicide in farmers compared to non-farmers in Switzerland, with the gap widening increasingly after 2006. It underlines the importance of identifying the difficulties and concerns of male farmers at an early stage in order to make appropriate structural adjustments and to offer low-threshold assistance tailored to their needs and preferences.

Keywords: *suicide, farming, occupational health, Switzerland, cohort study*

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Introduction

Suicide is a serious public health issue in Switzerland and the most frequent cause of death of people between the ages of 15 and 40 [1]. In 2016, Switzerland had an age-standardised suicide rate of 12.19 per 100,000, well above the European Union (EU-28) mean of 10.33 [2]. The suicide rate of men is 19.2 per 100,000, which is significantly higher than that of women, 6.0 per 100,000 [2]. About two thirds of suicides are committed by men, who frequently use violent methods such as firearms and hanging, whereas poisoning is more common in women [3].

National economic crises [4–6] and personal socio-economic factors [7, 8] are known risk factors for suicide. The risk also differs according to occupation [9], with studies from several countries showing an elevated risk for suicide in farmers [9–13]. In France, male farmers had a standardised mortality ratio (SMR) for suicide of 1.28 in 2008 and 1.22 in 2009 [10]. A meta-analytical review of suicide and occupation which included studies from Canada, USA, Denmark, Finland, Iceland, UK, New Zealand and Australia found a 60% higher suicide risk for skilled agricultural, forestry and fishery workers compared to the general population [9].

Qualitative studies have identified several factors associated with a higher suicide risk in Australian farmers [14, 15]: acute situational stressors, such as problematic romantic relationships, financial concerns or pending retirement, rural communities undergoing protracted change, changing rural communities, community attitudes, psychiatric disorders and the stigma attached to the latter. The easy access to suicide methods (hanging, firearms, pesticides) presents another risk factor for this occupational group [16]. Working conditions such as long working hours, few vacations and often working on their own or at best with their family might also contribute to a higher suicide risk. Stress is

associated with mental disorders such as depression and anxiety [17]. Most of the studies comparing farmers' mental health with other occupational groups suggest farmers have worse mental health than the general population [17]. The four most-cited influences on this are pesticide exposure, financial difficulties, climatic variability and poor physical health [17].

In Switzerland, conditions for those involved in agriculture have changed substantially over the last fifty years [18]. After World War II, agricultural policies were aimed at ensuring the agricultural sector was stable and could provide the Swiss population with food in times of crisis. This resulted in overproduction and high costs. Starting in 1990, there have been several reforms to agricultural policies aimed at ensuring market-oriented prices and direct payments for sustainable agriculture [18]. Another result of this restructuring was a significant reduction in the number of farms and farmers. From 1975 to 2015, the number of persons working on farms dropped by more than half to about 150,000 [19], and the number of farms decreased from 111,302 in 1975 to 50,852 in 2018 [20]. The income per farm recovered after a slump in the 1990s and has risen steadily in recent years [21, 22].

Agricultural reforms, increasing requirements for animal protection and food safety, and higher economic pressure present serious challenges for many Swiss farmers. In the last few years the media has reported an increase in suicide in this profession [23–25]. These articles were based not on quantitative analyses, but on individual impressions and individual fates. An analysis of occupation-specific mortality risks from 1978-83 showed a 25% higher suicide rate for Swiss male farmers compared to other professions [26]. And a recent analysis of suicide mortality by occupation from 1990 to 2014 confirmed agriculture as an activity with a significant excess of suicide in Swiss working-age men, reporting an SMR of 1.42 (95% CI 1.02-1.98) among agricultural, fishery and related labourers [27]. The aim of this study was to investigate whether Swiss male farmers have a higher risk of suicide than men with other professions, and whether this difference has increased from 1991 to 2014. In addition, we wanted to analyse whether differences in suicide rates are associated with differences in socioeconomic factors such as marital status, religion and language region.

Methods

The Swiss National Cohort

We analysed the Swiss National Cohort (SNC), a population-based longitudinal study of mortality in Switzerland. The SNC is based on probabilistic and deterministic linkages of the 1990 and 2000 censuses with death or emigration records up to 2014 and the Registry Based Census (RBC), which was introduced in 2011 [28, 29]. The mandatory census produced a population coverage estimated at 98.6% [30]. The SNC was approved by the Cantonal Ethics Committees of Bern and Zurich, and this approval also applies for the present analysis. The core SNC is described in detail elsewhere [28, 29]. For this study, we analysed men in the 1990 or 2000 censuses who were between the ages of 35 and 74 during the study period. In order to obtain a study population where farmers and non-farmers were as similar as possible regarding other characteristics, we excluded foreigners, men residing in collective facilities such as disabled or penal institutions, and those living in municipalities with over 50,000 inhabitants in 2010. Information from the 1990 census was used to identify variables (type of household, religion, etc.) for the study period 1991–2000, and information from the 2000 census was used for the period 2001–2014, as the RBC does not contain the same detailed information. For marital status updates, we used information on the last change before RBC 2011 or any others recorded before death.

Identification of farmers

The self-reported current main professions in the 1990 and 2000 censuses were categorised by the Swiss Federal Statistical Office (FSO) using a specific five-digit code. We identified farmers using code 11101 (definition of farmers). We also conducted a sensitivity analysis using a more comprehensive definition of farmers which also included men who had described themselves in the census as working in other agricultural professions such as breeder of poultry, small or large livestock, or fish (using codes 11101, 11102, 11103, 11201, 11202, 11203, 11301, 11302, 11303, 11304, 11305).

Identification of suicides

We consulted the causes of death recorded on death certificates to identify suicides. These were coded according to the International Classification of Diseases, eighth revision (ICD-8) from 1991 to 1994, and thereafter according to the tenth revision (ICD-10). We included the following methods of suicide: (i) poisoning (ICD-8 950–952, ICD-10 X60–X69, except X61.8); (ii) hanging (ICD-8 953, ICD-10 X70); (iii) drowning (ICD-8 954, ICD-10 X71); (iv) firearms (ICD-8 955, ICD-10 X72–X75); (v) cutting (ICD-8 956, ICD-10 X78); (vi) jumping (ICD-8 957, ICD-10 X80); (vii) train (ICD-8 958.00, ICD-10 X81-X82); other (ICD-8 958 with exception of 958.00, ICD-10 X83–84). We excluded suicides identified by the Federal Statistical Office (FSO) as assisted deaths, based on information on the death certificate given by the attending physician or the Institutes of Forensic Medicine.

Statistical analysis

We performed a survival analysis within the SNC with age as a time scale. Observation times started at the latest on the individual's 35th birthday or on 1 January 1991 and ended at the earliest on their 75th birthday, the date of death or emigration, or on 31 December 2014. For individuals in the 1990 census who could not be linked to an entry in the 2000 census and for whom there was no linked date of death or emigration, observation time ended on 4 December 2000, the day before the 2000 census. The data was analysed in four-year periods (1991–1994, 1995–1998, 1999–2002, 2003–2006, 2007–2010, 2011–2014). To describe the development of suicide rates in farmers and in men with other professions, crude and age-standardised rates of suicide were calculated using the European Standard Population 2013 [31]. For all calendar periods, we analysed the differences between farmers and men with other professions with standardised mortality ratios (SMRs). We determined an overall SMR over all time periods using random effect meta-analysis.

To investigate whether socioeconomic factors such as marital status can explain the differences in suicide rates found between farmers and men with other professions, three Cox proportional hazard regression models of increasing complexity with age as the time scale and suicide as the end-point were implemented to estimate hazard ratios. Cox regression Model 1 included only information about profession (farmer, non-farmer) and timeframe (four-year periods) as independent variables. Model 2 included in addition details about marital status (married, single, widowed, divorced). Model 3 added data regarding type of household (single, two or more persons), religious affiliation (Protestant, Catholic, no affiliation, other/unknown), and language region (German-, French-, Italian-speaking part of Switzerland).We also tested for interactions between profession (farmer, non-farmer) and marital status, type of household, religious affiliation and language region.

We determined the ICD codes of any comorbidities on the death certificates and identified mental and behavioural disorders (ICD-8 290–390 and ICD-10 F00-F99). The odds ratio for having a mental disorder registered on the death certificate (dependent variable) was then calculated with a multivariable logistic regression model that included profession (farmer, non-farmer), age category (in five-year bands) and year of death as independent variables.

To analyse time trends for the most common methods of suicide in men 35 to 74 years old (firearms and hanging), we performed a Poisson analysis with suicide by firearm or by hanging as the outcome, and calendar year (continuous) and profession (farmer vs non-farmer) as independent variables and tested for interactions between calendar year and profession.

Statistical analyses were performed using Stata version 15 (Stata Corporation, College Station, TX, USA). Results are given as rates per 100,000 person years, hazard ratios (HR), odds ratios (ORs), and standardised mortality ratios (SMRs) and their 95% confidence intervals (CIs).

Results

Study population

We identified 2,984,884 men between 35 and 75 years old who were living in Switzerland during the study period. Of these, 91,207 declared their profession as "farmer" in at least one census. After excluding foreigners and men living in collective households or in cities with 50,000 or more inhabitants, we were left with 1,796,379 men in the study population, 89,303 of them farmers (fig. 1). During the period investigated, 9006 suicides occurred in the study population, with the number decreasing from 1709 suicides between 1991 and 1994 to 1203 suicides between 2011 and 2014 (table 1). In farmers, 447 suicides were registered, decreasing from 113 in the first four-year period to 55 between 2011 and 2014. The mean and median age at suicide was 55 in farmers. In men with other professions, the mean age at suicide was 54 and the median age was 53 years.

Age-standardised rates

Age-standardised rates of suicide per 100,000 person-years were higher in farmers (38.1, 95% CI 34.6–41.8) than in all the men included in the study (32.6, 95% CI 31.9–33.3) (table 2). The age-standardised rates in farmers decreased from 45.0 (37.0–54.2) in 1991–1994 to 33.7 (25.0–44.5) in 2011–2014. In men with other professions, the reduction was more pronounced, starting at 41.9 (39.8–44.1) in 1991-1994 and ending at 24.0 (22.6–25.5) in 2011–2014. The declining trend seen in both populations in the earlier years continued in men with other professions, but in farmers it flattened out and subsequently increased again after 2006 (table 2 and fig. 2).

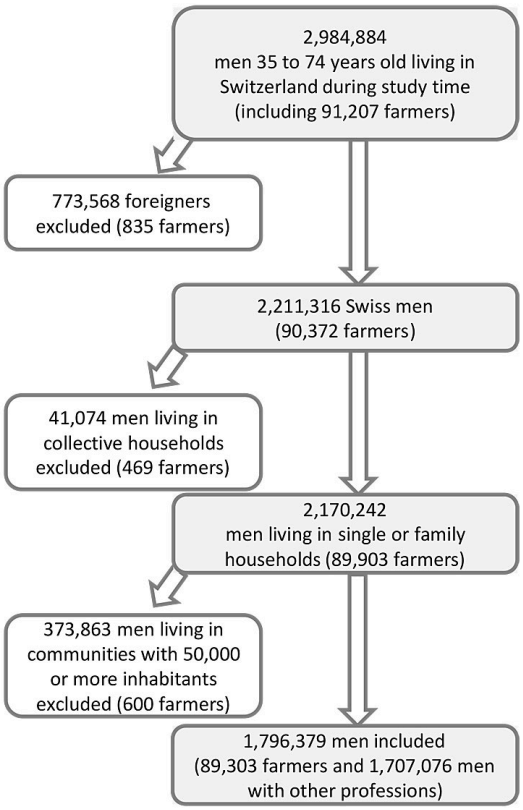
Age-standardised suicide rates were higher in widowed, divorced and single men than in married men; higher in men with no religious affiliation than in Protestant or Catholic men; and higher in men living in the French-speaking region of Switzerland than in those living in the German- or Italian-speaking regions.

The widening gap also showed in the SMRs comparing farmers with all the men included in the study (fig. 3). The SMRs ranged from 1.04 to 1.11, with the confidence intervals all including 1, in the four 4-year periods from 1991 to 2006. Starting from 2007–2010, the SMR increases from 1.06 (0.88–1.27) to 1.37 (1.05–1.79) in the 2011–2014 calendar period. A random effects meta-analysis of all calendar periods resulted in an average SMR of 1.11 (1.01–1.22).

Multivariable Cox regression models

All three Cox regression model analyses showed a higher suicide rate for farmers, with a slightly increasing hazard ratio, from 1.10 (95% CI 1.00–1.22) in Model 1 to 1.17

Figure 1: Flow chart of study inclusion parameters.



(95% CI 1.07–1.29) in Model 3 (table 3). The multivariable Cox analysis confirmed that being single, widowed or divorced, living alone, and a lack of religious affiliation were risk factors for suicide. Men aged 35 to 74 years from the French-speaking part of Switzerland had the highest risk of suicide, followed by those in the German-speaking

Table 1: Characteristics of male farmers and the male population with other professions at study entry, and the number of suicides.

		Male farmers				Men with other professions			
		All		Death by suicide		All		Death by suicide	
		Number	%	Number	%	Number	%	Number	%
Total		89,303		447		1,707,076		8559	
Age	35–44	40,404	45.24	81†	18.12	1,067,156	62.51	2133†	24.92
	45–54	15,342	17.18	137†	30.65	272,912	15.99	2620†	30.61
	55–64	17,433	19.52	145†	32.44	210,959	12.36	2160†	25.24
	65–74	16,124	18.06	84†	18.79	156,049	9.14	1646†	19.23
Calendar period	1991–1994	64,643*		113†	25.28	935,496*		1596†	18.65
	1995–1998	63,021*		104†	23.27	985,627*		1546†	18.06
	1999–2002	60,952*		73†	16.33	1,030,995*		1509†	17.63
	2003–2006	56,870*		48†	10.74	1,049,646*		1397†	16.32
	2007–2010	53,557*		54†	12.08	1,140,919*		1363†	15.92
	2011–2014	49,360*		55†	12.30	1,098,264*		1148†	13.41
Religion	Protestant	48,898	54.76	256	57.27	776,979	45.52	3855	45.04
	Catholic	38,752	43.39	180	40.27	740,841	43.40	3233	37.77
	No affiliation	871	0.98	6	1.34	148,888	8.72	1,212	14.16
	Other/unknown	782	0.88	5	1.12	40,368	2.36	259	3.03
Education	Primary	31,731	35.53	187	41.83	228,235	13.37	1371	16.02
	Secondary	47,720	53.44	219	48.99	1,035,419	60.65	5102	59.61
	Tertiary	9305	10.42	38	8.50	422,331	24.74	1986	23.20
	Unknown	547	0.61	3	0.67	21,091	1.24	100	1.17
Marital status	Single	18,736	20.98	123	27.52	465,322	27.26	1980	23.13
	Married	67,750	75.87	290	64.88	1,131,964	66.31	5,172	60.43
	Widowed	1715	1.92	12	2.68	21,502	1.26	237	2.77
	Divorced	1102	1.23	22	4.92	88,288	5.17	1170	13.67
Type of household	Single	4800	5.37	44	9.84	259,768	15.22	2033	23.75
	Two or more	84,503	94.63	403	90.16	1,447,308	84.78	6526	76.25
Language Region	German	69,447	77.7	326	72.93	1,260,909	73.86	6260	73.14
	French	17,177	19.2	109	24.38	368,251	21.57	2035	23.78
	Italian	1375	1.54	5	1.12	70,339	4.12	226	2.64
	Romansh	1304	1.46	7	1.57	7,577	0.44	38	0.44

* Number of men included at beginning of calendar period † Age and calendar period at time of death

Table 2: Age-standardised rates* of suicide in male farmers and men with other professions included in the study.

		Deaths per 100,000 person-years (95% CI)	
		Male farmers	Men with other professions
Total		38.1 (34.6–41.8)	32.6 (31.9–33.3)
Calendar period	1991–1994	45.0 (37.0– 54.2)	41.9 (39.8–44.1)
	1995–1998	42.1 (34.3–51.2)	38.9 (37.0–41.0)
	1999–2002	38.4 (30.0–48.3)	35.0 (33.2–36.9)
	2003–2006	32.5 (23.5–43.8)	30.0 (28.4–31.6)
	2007–2010	32.7 (24.5–42.9)	28.8 (27.3–30.4)
	2011–2014	33.7 (25.0– 44.5)	24.0 (22.6–25.5)
Marital status	Single	72.7 (60.3–87.0)	56.2 (53.2–59.4)
	Married	30.2 (26.8–33.9)	26.3 (25.5–27.0)
	Widowed	103.4 (17.3–304.7)	62.6 (47.4–80.9)
	Divorced	71.3 (43.5–110.6)	52.0 (49.0–55.3)
Type of household	Single	77.0 (55.6–103.7)	57.2 (54.6–59.9)
	Two or more	36.2 (32.7–40.0)	28.9 (28.2–29.6)
Religion	Protestant	39.1 (34.4–44.3)	33.4 (32.4–34.5)
	Catholic	36.5 (31.4–42.3)	29.1 (28.1– 30.1)
	No affiliation	44.5 (15.8–98.7)	43.9 (41.3– 46.5)
	Other/unknown	37.0 (12.0–87.9)	32.8 (28.9– 37.2)
Language Region	German	35.5 (31.7–39.6)	32.2 (31.4–33.0)
	French	49.3 (40.4–59.5)	36.5 (34.9– 38.1)
	Italian	22.9 (6.1–60.9)	21.0 (18.3–23.9)
	Romansh	42.0 (16.8–87.0)	32.8 (23.2– 45.0)

* Compared with the European Standard Population (2013)

region. Male farmers from the Italian-speaking part had the lowest risk of suicide of all the groups studied.

There were no significant interactions between profession (farmer vs non-farmer) and marital status (p = 0.34), type of household (p = 0.76), religious affiliation (p = 0.96) or language region (p = 0.37).

Figure 2: Age-standardised* suicide rates of the study population: farmers and men with other professions by calendar period (95% confidence intervals), all methods of suicide (navy), suicides by hanging (grey) and suicides by firearms (orange).* Compared with with the European Standard Population (2013)

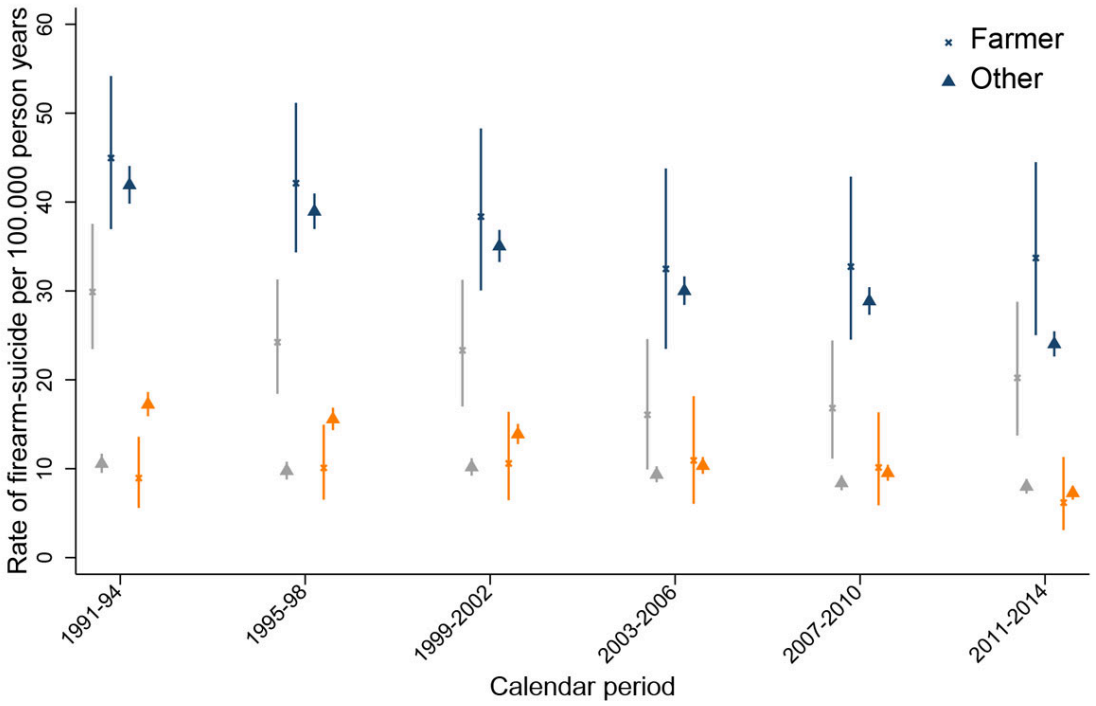
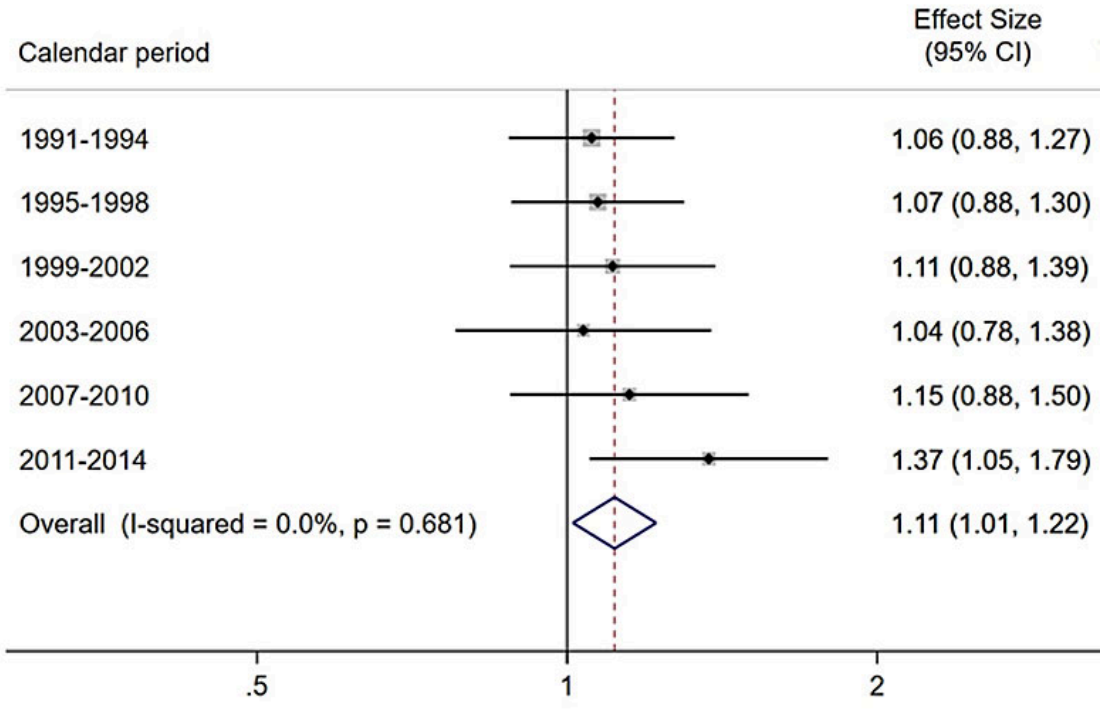


Figure 3: Standardised mortality ratios comparing suicide rates in male farmers with all the men included in the study (95% confidence intervals), per time period and over all calendar periods.



Mental comorbidities

In 201 (45%) of the 447 farmer suicides, the death certificates reported a mental comorbidity, compared to in 35% of suicides in men with other professions. According to the logistic regression model, farmers who died by suicide were 57% more likely to have a mental comorbidity mentioned on the death certificate compared to non-farmers (OR 1.57, 95% CI 1.30–1.91).

Means of suicide

More than half of all farmer suicides were by hanging (266 or 59.5%), followed by firearms (24.8%) and poisoning (5.6%) (table 4). In men with other professions, suicide by firearms was the most common method (3175 events, 37.1%), followed by hanging (28.7%) and poisoning (11.2%) (table 4). The time trends of age-standardised rates of suicide per 100,000 person-years for suicides by hanging and by firearms show a decline in suicides by firearms among men with other professions, which is not observed to the same extent among farmers (fig. 2). The multivariable Poisson regression model with suicide by firearm as outcome and profession (farmer vs non-farmer) and calendar year (continuous) as independent variables showed a significant interaction ($p < 0.007$). Suicides by firearms decreased by 4.1% ($p < 0.001$) per year in men with other professions but did not decrease in farmers ($p = 0.82$). Suicides by hanging decreased by 1.1% ($p < 0.001$) in men with other professions and by 2.5% ($p = 0.006$) in farmers, but there was no significant interaction between profession and calendar year for suicides by hanging ($p = 0.18$).

Sensitivity analysis

In the analysis with the more comprehensive definition, 99,981 men were classified as farmers and 1,969,398 as men with other professions. During the study period, 504 suicides occurred in farmers and 8,502 in men with other professions. Age-standardised rates of suicide were 38.5 (95% CI 35.2–42.1) in farmers and 32.6 (95% CI 31.9–33.3) in men with other professions. The results of the Cox regression models and the SMRs were similar to the results of the analysis with the narrower definition of farmer (supplementary table S1 and fig. S1 in appendix 1).

Table 3: Hazard ratios and 95% confidence intervals (CI)s for suicide from multivariable Cox regression models including profession, calendar period (Model 1), marital status (Model 2), and type of household, religion and language region (Model 3) as predictor variables.

Cox regression model		Only farmers and calendar period	+ Marital status	+ Type of household, religion and language region
		Hazard ratio (95% CI)	Hazard ratio (95% CI)	Hazard ratio (95% CI)
Profession	Non-farmers	1 (ref)	1 (ref)	1 (ref)
	Farmers	1.10 (1.00–1.22)	1.13 (1.03–1.24)	1.17 (1.07–1.29)
Calendar periods	1991–1994	1 (ref)	1 (ref)	1 (ref)
	1995–1998	0.92 (0.86–0.99)	0.90 (0.84–0.97)	0.91 (0.85–0.97)
	1999–2002	0.83 (0.78–0.89)	0.79 (0.74–0.85)	0.79 (0.74–0.84)
	2003–2006	0.71 (0.66–0.76)	0.67 (0.63–0.72)	0.66 (0.62–0.71)
	2007–2010	0.69 (0.64–0.74)	0.63 (0.58–0.67)	0.62 (0.58–0.66)
	2011–2014	0.58 (0.54–0.62)	0.51 (0.47–0.55)	0.50 (0.47–0.54)
Marital status	Married		1 (ref)	1 (ref)
	Single		2.23 (2.11–2.35)	1.94 (1.82–2.06)
	Widowed		2.05 (1.80–2.34)	1.83 (1.60–2.08)
	Divorced		2.09 (1.96–2.22)	1.78 (1.66–1.91)
Type of household	Two or more persons			1 (ref)
	Single			1.32 (1.24–1.40)
Religion	Protestant			1 (ref)
	Catholic			0.90 (0.86–0.94)
	No affiliation			1.22 (1.14–1.30)
	Other			0.97 (0.85–1.09)
Language region	German			1 (ref)
	French			1.14 (1.09–1.20)
	Italian			0.67 (0.59–0.77)

Table 4: Methods of suicide, absolute numbers and percentages for all suicides in male farmers and in men with other professions.

	Farmers		Men with other professions	
	Number	Percent	Number	Percent
Poisoning	25	5.6	962	11.2
Hanging	266	59.5	2455	28.7
Drowning	17	3.8	306	3.6
Firearms	111	24.8	3175	37.1
Cutting	7	1.6	202	2.4
Jumping	4	0.9	606	7.1
Train	12	2.7	635	7.4
Other	5	1.1	218	2.6
Total	447	100.0	8559	100.0

Discussion

The study found a slightly higher rate of suicide in male farmers compared to other men aged 35 to 74 years who were living in rural communities in Switzerland. The declining trend seen in all men from 1991 to 2005 continued in men with other professions, but in farmers it flattened out and subsequently increased again after 2006. Therefore, the difference in suicide rates increased after 2006 and reached a 37% higher rate of suicide for farmers in the 2011–2014 calendar period. This higher risk could not be explained by differences in marital status or type of household: the discrepancy even seems to increase when these social factors are corrected for. Hanging was most common method amongst Swiss farmers, while usage of firearms was more common in non-farmers of the same age living in rural communities.

The higher rate of suicide in Swiss farmers corresponds with study results from other European countries [9, 10, 12, 31], and worldwide [14, 32]. In France, the SMR of farmers ranged between 1.11 and 1.28 from 2007 to 2009 [10]. In a worldwide meta-analysis of 32 studies analysing suicide risk among agricultural, forestry and fishery workers, the pooled effect size for men was 1.50 (95% CI 1.30–1.72) [31].

Financial concerns have been identified as a risk factor for suicide in Australian farmers [14]. This may also play a significant role in Switzerland, but we did not have information on the economic status of individual farms. Agricultural sector statistics, however, show a 60% decrease in the number of farms from 92,815 in 1990 to 54,057 in 2014 [33]. Income per farm remained more or less stable during the study period [33], but when the high workload and the region are taken into account, wages lie 30% to 50% below the median gross income of all secondary and tertiary sector workers in the country [22].

The widening gap in suicide rates between farmers and non-farmers seen after 2006 is worrying. This development coincides with the end of the 2007 and the beginning of the 2011 agricultural policies, and therefore with the complete abolition of milk quotas that came into effect in 2009. However, the data did not distinguish between different types of farmers or allow a causal linking of results with reform processes in agricultural policy. Suicide and its associated risk factors present a very complex reality [34]. Risk factors can exist on many levels, from the individual, to the familial, social, economic, and ecologic or cultural. It is often a combination of factors that drives someone to take his own life [35].

The growing difference in the suicide rates of farmers compared to non-farmers is also reinforced by a continuous decrease in suicide rates in non-farmers. Earlier studies have concluded that the decline in suicides in younger men after 2003 is partly attributable to the Army XXI reform [3, 36], which halved the number of Swiss soldiers and reduced the availability of firearms in the country. We did not find any decrease in suicides by firearms in farmers, in contrast to men with other professions. Limiting access to lethal methods is an important strategy for suicide prevention [37]. The means for hanging, the method most often used by farmers, however, cannot be restricted [37].

The observed decline in suicide rates in non-farmers may also be explained by an improvement in the treatment of psychiatric disorders [38] – *the* most important risk factor for suicide. As a group, farmers may be more reluctant to seek help for mental health problems [39]. It could be that they have fewer options for care in their local surroundings, are less informed about mental health difficulties and any available help or are more sensitive to the stigma of acknowledging such problems [11, 40]. In Switzerland, the density of mental health services is significantly lower in rural areas than in urban areas, and this density is a good predictor of the use of mental health services [41]. Interestingly, a recent study found a lower SMR for suicide in female crop and animal producers compared to the general female population in Switzerland [27]. This indicates that a possible lack of psychiatric treatment of farmers in Switzerland could be a male-specific problem. Help-seeking characteristics among male farmers are poorly understood and may be dominated by an “I do it all by myself approach” [40, 42].

Strengths and limitations

This is the first detailed analysis of quantitative data on suicide amongst farmers in Switzerland. The SNC is a longitudinal mortality study of the entire Swiss population which provides data at the level of individuals, households, and buildings [28, 29]. An important strength of the study is its coverage of the entire nation.

We identified individuals as farmers if they declared themselves as such in the 1990 or the 2000 censuses. No adaptions were possible between those two censuses, or after the 2000 census. However, suicides of farmers who quit their job either a few months or even years before might also be of interest. In addition, as profession is self-reported in the census, the term farming might not reflect the complete job profile.

Unfortunately, there are no data regarding mental health and psychiatric care of farmers in Switzerland. We did, however, find a higher proportion of death certificates mentioning mental health problems in suicides by farmers than for other professions. Studies have also shown higher psychological morbidity among male farmers compared to non-farmers in the UK [43], and a higher prevalence of depression among male and female farmers in Norway [39].

Routine mortality statistics underestimate the number of suicides: some might be coded as other causes [44]. Misclassification may be less likely in Switzerland because death registration is anonymous, and families and local authorities do not receive a copy of the death certificate. We excluded assisted suicides from the analysis, but these were only reliably identifiable after 2003. It may be that some suicides by poisoning before 2003 might actually have been assisted suicides, although poisoning is not a very common method in men aged 35 to 75 [3].

Although the higher suicide risk for farmers in our study could not be explained by sociodemographic risk factors such as being single, divorced or widowed, or living alone, we cannot exclude relationship problems as an important factor. The data on type of household was only recorded in the 1990 and 2000 censuses and is therefore not completely up to date at every time point. Data on marital status is more current but does not reflect the quality of a relation-

ship. The familial or financial situation on a farm might delay or prevent a divorce even if the relationship has long broken down.

In conclusion, our study shows a higher rate of suicide in male farmers compared to non-farmers in Switzerland, with the gap widening since 2006. This detailed analysis within the SNC confirms what has been feared after reports of individual cases appeared in the media. It provides evidence for the need for widespread social support measures for farmers and their families who find themselves in phases of economic transition. The study underlines the importance of identifying ways to recognise farmers' difficulties and concerns at an early stage and of offering low-threshold help on structural, economic and individual levels.

Acknowledgments

The authors would like to thank Erica Holt for her editorial services. We thank the Federal Statistical Office (FSO) for providing mortality and census data and for the support that made the Swiss National Cohort and this study possible. The members of the Swiss National Cohort Study Group are Matthias Egger (Chairman of the Executive Board), Adrian Spoerri and Marcel Zwahlen (all Bern), Milo Puhan (Chairman of the Scientific Board), Matthias Bopp (both Zurich), Martin Röösli (Basel), Murielle Bochud (Lausanne) and Michel Oris (Geneva).

Financial disclosure

This work was supported by the Swiss National Science Foundation (grant nos. 3347CO_108806, 33CS30_134273 and 33CS30_148415). The SNSF had no role in the study design, data collection and analysis, decision to publish or preparation of the manuscript.

Potential competing interests

The authors declare no conflicts of interest relevant to this article.

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Appendix 1

Supplementary data

The appendix is available as a separate file at https://smw.ch/article/doi/smw.2020.20251.